



National Academy of Sciences Quarks to the Cosmos Booklet

Presentation to HEPAP

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Why now?

- *Connecting Quarks with the Cosmos* was well received in Washington
 - It elevated and focused attention on scientific opportunities at the intersection of physics and astronomy
- *The Science Ahead, The Way to Discovery* charted a twenty-year future for particle physics
 - It outlined the goals, key research avenues, and strategy of elementary particle physics

Why now?

- Today, the scientific connections between elementary particle physics and cosmology are increasingly strong
 - Both fields are entering exciting new eras
- In policy circles, support for and interest in these connections is also strong
 - OSTP has formed an interagency working group
- Current level of attention creates an opportunity to build on that momentum
 - The time is right for an NRC booklet to highlight the connections between particle physics and cosmology

Popular booklet

- Create a professionally produced, richly illustrated popular booklet
 - Articulate the current questions
 - Point out the ripe opportunities for addressing them
- Connect “*what we want to know*” in particle physics and cosmology with “*what we can do*”





Particle physics & cosmology are joined by their common questions

- How did the Universe come to be?
 - What is the dark energy that holds the Universe together?
 - What is the dark energy that is accelerating its expansion?
 - What happened to antimatter?
 - What are the dynamics of inflation?

Particle physics & cosmology are joined by their common questions

- What are the ultimate laws of nature?
 - Are there new forces, beyond what we see today?
 - Do the forces of nature unify?
 - ◆ Is the proton absolutely stable?
 - ◆ What governs the pattern of particle masses?
 - What completes the Standard Model?
 - ◆ What lies beyond quarks and leptons?
 - ◆ Is there a Higgs particle?
 - ◆ How do neutrinos fit in?

Particle physics & cosmology are joined by their common questions

- What is the structure of space and time?
 - Are there additional spacetime dimensions?
 - ◆ Are they classical or quantum?
 - ◆ What are their shapes and sizes?
 - What is the quantum theory of gravity?
 - What is the state of the vacuum?
 - What is mass?

Physics of the Universe

Work plan

- Under the NRC study process, we will convene a 6-8 person writing committee
- We will carefully task the writing group to
 - Focus on the science
 - Emphasize “what we want to know”
 - Not set priorities or focus on specific projects
- We envisage a 12 month process, with assistance from professional writers and illustrators
- The result will not be a new assessment of particle physics and cosmology, but a repackaging of existing reports